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Prioritizing Faculty of Engineering Education Performance by Using AHP-TOPSIS and Balanced Scorecard Approach

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Abstract: ***In today's world of global competition, providing quality service is a key for success, and many experts concur that the most powerful competitive trend currently shaping marketing and business strategy is service quality. Institutes of higher education are also focusing on ways to render high quality education to their educators and have a better performance. Higher education institutes are facing new challenges in order to improve the quality of education. There is a pressure for restructuring and reforming higher education in order to provide quality education and bring up graduates who become fruitful members of their societies. Therefore, these institutes are trying to recognize the dimensions of a quality education and define strategies to reach their pre-defined standards and goals. The first objective of this article is proposed a balanced scorecard as a performance evaluation model for engineering educational systems. The second objective prioritizes performance indicators within engineering education balanced scorecard using AHP-TOPSIS. This study will collect and arrange suitable performance evaluation configurations and indices by literature reviews and interviews to department heads in engineering educational systems.***

***Index Terms*— MCDM: multiple criteria decision-making, AHP: Analytic Hierarchy Process, TOPSIS: Technique for Order Preference by Similarity to Ideal Solution.**

I. INTRODUCTION AND REVIEW

A. Introduction

Quality in higher education is a complex and multifaceted concept and a single appropriate definition of quality is lacking, Harvey and Green [1]. As a consequence, consensus concerning "the best way to define and measure service quality" Clewes [2] does not as yet exist. Every stakeholder in higher education (e.g., students, government, professional bodies) has a particular view of quality dependent on their specific needs. O'Neill and Palmer [3] define service quality in higher education as "the difference between what a student expects to receive and his/her perceptions of actual delivery". Guolla [4] shows that students' perceived service quality is an antecedent to student satisfaction. Positive perceptions of service quality can lead to student satisfaction and satisfied students may attract new students through word-of-mouth communication and return themselves to the university to take further courses. Zeithaml et al. [5] distinguish between three types of service expectations: 1) desired service, 2) adequate service, and 3) predicted service. Customers have a desired level of service which they hope to receive comprising what customers believe can be performed and what should be performed. Customers also have a minimum level of acceptable service as they realize that service will not always reach the desired levels; this is the adequate service level. Between these two service levels is a zone of tolerance that customers are willing to accept. Finally, customers have a predicted level of service, which is the level of service they believe the company will perform.

B. Balanced Scorecard in Public and Non-Profit Organizations

Non-profit organizations usually take their mission based on reducing their costs, improving quality and doing their works more efficiently, hence the greatest difference between businesses and non-profit organizations is in their missions Kettunen [6]. Therefore when using the BSC in the field of nonprofit organizations and public sector, the financial perspective ought to have a inferior role. The original sequence of the BSC perspectives is not fixed; it can be adjusted according to individual case studies or industry culture characteristics (Chen et al. [7]. Kaplan and Norton [8], [9] stated that the general architecture of the BSC can be modified in order to best fit the nature of the organization, especially if it operates in the public or non-profit sectors. Kaplan and Norton [8] have indicated that the organizational mission of governmental and non-profit organizations is not reflected only by financial measurement; rather the mission of government or non-profit organization should be placed at top of the BSC in measuring whether such an organization has been successful. The organizational mission is followed by the

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customer, internal process, learning and growth, and financial perspectives because Kaplan [8] recommended placing the customer/constituent perspective at the top of perspectives hierarchy for non-profit organizations. Regarding the implementation of the BSC for non-profit organizations, the United Way of Southeastern New England (UWSENE) was the first non-profit organization to introduce the BSC according to Kaplan and Norton, [8]. According to Wilson et al. [10], the financial perspective was changed to the shareholder perspective and the customer perspective remained at the same level in the balanced scorecard established by the Canada National Department of British Columbia Buildings Corporation (BCBC). In another case, the BSC was applied as a performance management tool for FUNARBE by Gomes and Liddle[11]. FUNARBE is a 300-employee strong organization located on the edge of the Federal University of Viçosa Campus. Nopadol [12], and panagiotis [13]discussed the limitations of balanced scorecard that focused in assumption of cause-effect relationships across the four major perspectives is problematic and the design techniques are poor in illustrating the dynamics of a system (absence of feedback loops).The present work will take this draw back into consideration as will be shown later.

C. Balanced Scorecard in Higher Education

Higher-education plays a vital role in countries' economic growth and shaping the future of the nation. Nowadays educational institutions are experiencing challenges such as rapid growth of information technology, globalization, increased competition and resource constraints. The successful realization of these institutions on the educational services market play a necessary role in attainment their defined goals, therefore focus and hence the performance assessment of higher education institutions become essential. So strategic planning and performance tracking has got great importance for such institutions. Although some studies have addressed the application of the BSC in the field of education, but in general there is a lack of academic research related to this issue [14]. Chang and Chow [15] stated that rather than focusing on financial measures, higher education has historically focused on academic measures. Dilanthi and Baldry [16] used BSC to measure the performance of the educational institutions. The study stresses on the relationship between performance measurement and performance quality under the model of BSC. According to Delker [17] in his paper developed BSC model for the California State University. Similarly Cullen, Joyce, Hassall and Broadbent [18] developed the BSC model for the Mid Ranking UK University. Karathanos and Karathanos [14] performed a study aimed at showing the performance indicators of the first three winners of the Malcolm Baldrige National Quality Award [7]. The study concentrated on the need for alignment of performance measures with vision, mission and strategic goals. Chen, Yang and Shiau (2006) have used the BSC to create a system for evaluating the performance of the Chin Nmin Institute of Technology in Taiwan. In another study conducted by Umashankar and Dutta [19], BSC was used to measure the efficiency of the management at Indian universities. The study found that the BSC could enable these universities to identify and correct significant deviations and design appropriate strategies. Nayeri, Mashhadi and Mohajeri [20] developed the BSC model in order to assess the strategic environment of higher education in the field of business in Iran. Raghunadhan [21] assessed the institutes of higher education which is funded by the government of India, and used the BCS to compare institutes surveyed. The results indicated that the concepts of strategic management are applied in these institutes. Beard [22] argued that the BSC is suitable for use in higher education, and he has shown many successful applications of the BSC in this area. Also, Umayal and Suganthi [23] presented a model for measuring performance of an educational institution based on BSC approach. Measurement criteria were also suggested to assess the performance according to the four perspectives of the BSC. In addition, Yu, Hamid, Ijab and Soo [24] discussed the appropriateness of adopting electronic BSC to measure the quality of performance for academic staff in higher education. The research showed that the electronic BSC is appropriate and effective for this purpose. A lot of researchers like Munteanu et al [25], Adcroft et al.[26], Mourad et al.[27], Mazzarol [28],

Durkin et al.[29] emphasized on the requirement of higher education organizations for collecting data based on student's expectations. Dhara Jha and Vijay [30] used BSC as a tool to manage the education academics. Seth. A. and Oyugi L. A. [31] studied the relationship between the balanced scorecard and organizational performance of higher learning in Kenya as a means of improving organizational performance. Josua Tarigan and very recently Deborah Christine [32] studied the relationship between non-financial performance and financial performance using balanced scorecard in higher education in Indonesia universities .Mohammad H Yarmohammadian et. al. [33] developed An Integrated strategic quality model and BSC applied on Iranian higher education system. Teresa et. al. studied the validation of a Balanced Scorecard (BSC) model and a Strategic Map for the University by

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studying the relationships of efficiency between its dimensions. This work determines factors of the performance in this type of institution. These factors are: the participation of teaching staff in innovation activities; the number of doctorate-level staff; the academic subjects and credits in the Virtual Campus; and the scores in the surveys of student satisfaction. Amene and Farhad [34] discussed performance evaluation in higher education institutes with the use of combinative model AHP and BSC.

D. Work Objectives

Although many higher education institutions are trying to do stakeholders expectations, there is still a need to pay more attention to quality of teaching and educational programs. These again perspectives, objectives and indicates at the requirement to reconsider at the ways institutions of higher learning are to be managed. One of the most successful performance measurements which have been widely implemented by various organizations during the previous years is Balanced Scorecard. Although these indicators are inter-connected to reach to organizational vision and mission, still BSC fails to provide any relationship between the importance of each of these perspectives, objectives and indicators. Therefore, this paper tried to fill this gap by studying and prioritizing the perspectives, objectives, and performance indicators of balanced scorecard model implemented in faculty of engineering by using AHP-TOPSIS model. This model provides a perfect framework to determine the importance of each of these perspectives, objectives and indicators.

II. BALANCED SCORECARD IN FACULTY OF ENGINEERING

Balanced scorecard has been used to measure the performance of faculty of engineering. For this purpose, educations criteria are chosen depending on SWOT analysis. The result of SWOT analysis is strategic objectives. These strategic objectives classified related to BSC perspectives. The relationships between strategic objectives (strategy map) have been drawn. Through such a strategy map, the cause-and-effect linkage can be better described, and strategy can be more clearly defined to examine the validity of examining strategy. A strategic map not only links with strategic targets, but also includes measurable indicators of different perspectives. After determining the strategic objectives, the indicators which measure performance faculty are chosen. The importances of these indicators are determined by using AHP-TOPSIS model. The BSC objectives help to achieve university strategic goals. Table 1 shows the objectives and performance indicators which have been defined for the faculty of engineering of performance assessment.

Table 1: The objectives and performance indicators for Faculty of Engineering

BSC Perspectives	Objectives	code	Indicator
Financial (FL)	Development the finance Capacity	A1	Budget allocated annually.
		A2	Annual revenue from tuition fees compared with the budget allocated annually.
		A3	The value of contracts with industry annually pound compared with the budget allocated annually.
		A4	Annual revenue from foreign donations with the budget allocated annually.
		A5	The value of external grants for the allocated budget.
		A6	Cost of salaries for the budget.
Customer (CT)	Customer satisfaction	B1	Students' satisfaction grade (1 to 10 scales).
	Customer retention	B2	University's position in national and international rankings.
	Customer acquisition	B3	The number of contracts with industry annually.
Customer (CT)	Reduce customer complaints	B4	Number of complaints made per month.
	Quality	C1	Ratio of academic staff to disciplinary.
		C2	Ratio of students to academic staff
		C3	Ratio of academic staff satisfaction of education level.
		C4	Ratio of students' staff satisfaction of education level.
		C5	Number of classrooms to the number of students.
		C6	Number of laps found to factor required for each department.
		C7	Ratio of students Satisfaction of teaching aids.

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Internal process (IP)	educational service.	C8	Number of graduate programs that need to be learned after graduation.
		C9	Number of books in library
		C10	Time cycle for up-to-dating the library.
		C11	Ratio of students Satisfaction of library service.
		C12	Time cycle for up-to-dating the computer and IT equipment's (teaching aids) of the faculty.
	Contribute to the development of integrated community.	C13	Number of research for an introduction to the development environment.
		C14	Number of projects that involved the overall development of the environment.
		C15	Number of certification labs which served the environment.
Learning and growth (L&G)	Raise the efficiency of faculty.	D1	Academic staff's satisfaction grade (1 to 10 scale)
		D2	Number of training courses, which was attended by members of the faculty.
		D3	Number of international conferences, which was attended by members of the faculty.
		D4	Average no. of papers by academic staff.
	Work on development educational process.	D5	Number of international agreements for the exchange of graduates.
		D6	No. of certified laps
	Preparation courses for continuing education and training.	D7	The number of faculty members who attended training sessions.
		D8	The number of faculty members who have participated in international conferences.
		D9	Number of practical projects, which was attended by members of the faculty in the development of society and the development environment.
		D10	Number of projects of environmental development which students in master and PhD degree programs involved in.
Management commitment (MC)	Leadership	E1	Does the organization establish appropriate communication process?
		E2	Does the leadership establish time table to achieve the project objectives.
		E3	Does the leadership ensuring the availability of resource.
		E4	Does the leadership conduct the review and take effective actions.
	Complete the organizational structure.	E5	Does the faculty have kind of organization structure?
		E6	Does the faculty determine job description, authority and responsibility for each position of organization structure?
	Development motivation mechanics.	E7	Does the faculty have policy of motivation?
		E8	How many person motivated bar moth?
	Development culture	E9	Does the organization work as a team and has awareness to achieve necessary competence.
	Development empowerment mechanics	E10	Does the faculty identify criteria to measurement the behavior changes according to training?

III. PROPOSED AHP-TOPSIS INTEGRATED APPROACH

There are various models for prioritizing factors in research. This study proposed new integrated approach model composed of AHP and TOPSIS methods consist of three basic stages: the first stage data gathering to Structure the hierarchy stage two deals with AHP computation where stage three in values determination of the final ranking.

A. The First Stage: Structuring the Hierarchy

This is the first stage; a problem is decomposed into a hierarchical structure that consists of an objective (i.e., overall goal of the decision making), the general criteria which impact the goal directly, sub-criteria (objectives), sub-sub-criteria (measures) etc.

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B. The Second Stage: Computing the Weights

In this stage, to determine the criteria weights, a team of experts formed pair wise comparison matrices for evaluating the criteria. Each expert of the team individual evaluation. Pair wise begins with comparing the relative importance of two selected items. The decision makers have to compare each element by using relative scale of pair wise comparison as shown in Table 2.[35]

Table 2: Scale for pair-wise comparisons

Relative intensity	Definition	Explanation
1	Similar importance (SI)	Two requirements are of equal value
3	Moderate importance (MI)	Experience slightly favors one requirement over another
5	Intense importance (II)	Experience strongly favors one requirement over another.
7	Demonstrated importance (DI)	A requirement is strongly favored and its dominance is demonstrated in practice.
9	Extreme importance (EI)	The evidence favoring one over another is of the highest possible order of affirmation.
2,4,6,8	Intermediate values	When compromise is needed

From the information of the pair wise comparison, we can form the judgment comparison reciprocal matrix as follows:

$$A = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ \vdots & \vdots & \cdots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{pmatrix} \quad (1)$$

To calculate the vectors of priorities, the average of normalized column (ANC) method is used. ANC is to divide the elements of each column by the sum of the column and then add the element in each resulting row and divide this sum by the number of elements in the row (n).as shown in eq. (2):

$$W_i = \frac{1}{n}\sum_{j=1}^{n}\frac{a_{ij}}{\sum_i^n a_{ij}}, i, j = 1,2,...n \quad (2)$$

The final operation called consistency verification, which is regarded as one of the most advantages of the AHP, is incorporated in order to measure the degree of consistency among the pair wise comparisons by computing the consistency ratio. The consistency is determined by the consistency ratio (CR). Consistency ratio (CR) is the ratio of consistency index (CI) to random index (RI) for the same order matrices. To calculate the consistency ratio (CR), there are three steps to be implemented as follows:

- *Firstly*, Calculate the Eigen value (λ max)

To calculate the Eigen value (λ max), multiply on the right matrix of judgments by the priority vector, obtaining a new vector.

- *Secondly*, Calculate the Consistency Index (CI).

The CI can be calculated using the eq. 3.

$$CI = (\lambda_{max} - n) / (n-1) \quad (3)$$

- *Finally*, Calculate the Consistency Ratio (CR).

The CR can be calculated using the eq. 4.

$$CR = CI/RI \quad (4)$$

Selecting the appropriate value of random index (RI) Table 3 according to the matrix size.

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Table 3: Random index of analytic hierarchy process

Size of matrix (n)	1	2	3	4	5	6	7	8	9	10	11	12
Random index (RI)	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.59

C. The Third Stage: Determining the Final Ranking

In the last stage, calculated weights of the factors are approved by decision making team. Ranking firms are determined by using TOPSIS method in the third stage. TOPSIS method is one of the well known ranking methods for MCDM. TOPSIS is firstly proposed by Hwang and Yoon. This technique based on the concept that rank alternatives, which has the shortest distance from the ideal (Best) solution and the longest distance from the ideal (worst) solution.[36]

Steps of TOPSIS

Step 1: Construct normalized decision matrix. This step transforms various attribute dimensions into non-dimensional attributes, which allows comparisons across criteria.
Normalize scores or data as follows:

$$r_{ij} = x_{ij} / \sqrt{(\Sigma a^2_{ij})} \quad \text{for } i = 1, \ldots, m; j = 1, \ldots, n \qquad (5)$$

Step 2: Construct the weighted normalized decision matrix. Assume we have a set of weights for each criteria w_j for $j = 1,\ldots n$.
Multiply each column of the normalized decision matrix by its associated weight. An element of the new matrix is:

$$v_{ij} = w_j r_{ij} \qquad (6)$$

Step 3: Determine the ideal and negative ideal solutions.
Ideal solution.

$$A^* = \{ v_1^*, \ldots, v_n^* \}, \text{ where}$$

$$v_j^* = \{ \max (v_{ij}) \text{ if } j \in J ; \ \min (v_{ij}) \text{ if } j \in J' \} \qquad (7)$$

Negative ideal solution.

$$A' = \{ v_1', \ldots, v_n' \}, \text{ where}$$

$$v' = \{ \min (v_{ij}) \text{ if } j \in J ; \ \max (v_{ij}) \text{ if } j \in J' \} \qquad (8)$$

Step 4: Calculate the separation measures for each alternative. The separation from the ideal alternative is:

$$S_i^* = \left[\sum_{j=1}^{n} (v_{ij} - v_j^*)^2 \right]^{1/2} \qquad i = 1, \ldots, m \qquad (9)$$

Similarly, the separation from the negative ideal alternative is:

$$S'_i = \left[\sum_{j=1}^{n} (v_{ij} - v_j')^2 \right]^{1/2} \qquad i = 1, \ldots, m \qquad (10)$$

Step 5: Calculate the relative closeness to the ideal solution C_i^*

$$C_i^* = S'_i / (S_i^* + S'_i) , \qquad 0 < Ci^* < 1 \qquad (11)$$

IV. VALIDITY AND RELIABILITY OF DATA GATHERING

The required data was gathered randomly from the faculty of engineering in Fayoum University. Totally, 110 questionnaires were distributed among which 86 questionnaires were returned (return rate of 78.18%). Table 3 shows the characteristics of the study sample society. The respondents were asked to choose the importance of the mentioned indicators based on a Likert scale. Because the questionnaire used in this research is a simple questionnaire for measuring the importance of several items and similar questionnaires have already been used in previous studies, its validity is confirmed. In order to test the reliability of the questionnaire, Cronbach's Alpha was found to be 0.727, which indicated that the questionnaire has high internal reliability.

Table 3: Sample Characteristics

Factor		Frequency	Percentage
Position	Professor	7	8.14%
	Assistant Professor	8	9.30%

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	Lecturer	12	13.95%
	Stuff	10	11.62%
	Researcher	6	6.97%
	Graduate	13	15.11%
	Student	30	34.88%

Agreement of participants' responses can be measured by the Spearman rank correlation which calculates the sums of the squares of the deviations among the different rankings. Table 4 represents Spearman's rank correlation coefficient among mentioned approaches. Figure 1 shows the variations in the rankings obtained by different responses.

Table 4: Spearman's rank correlation coefficient between respondents answer

Factor	Professor	Assistant Professor	Lecturer	Stuff	Researcher	Graduate	Student
Professor		0.4	0.2	0.8	0.7	0.3	0.52
Assistant Professor			0.4	0.6	0.9	0.9	0.1
Lecturer				0.0	0.3	.07	0.1
Stuff					0.7	0.3	0.73
Researcher						0.8	0.1
Graduate							-0.1
Student							

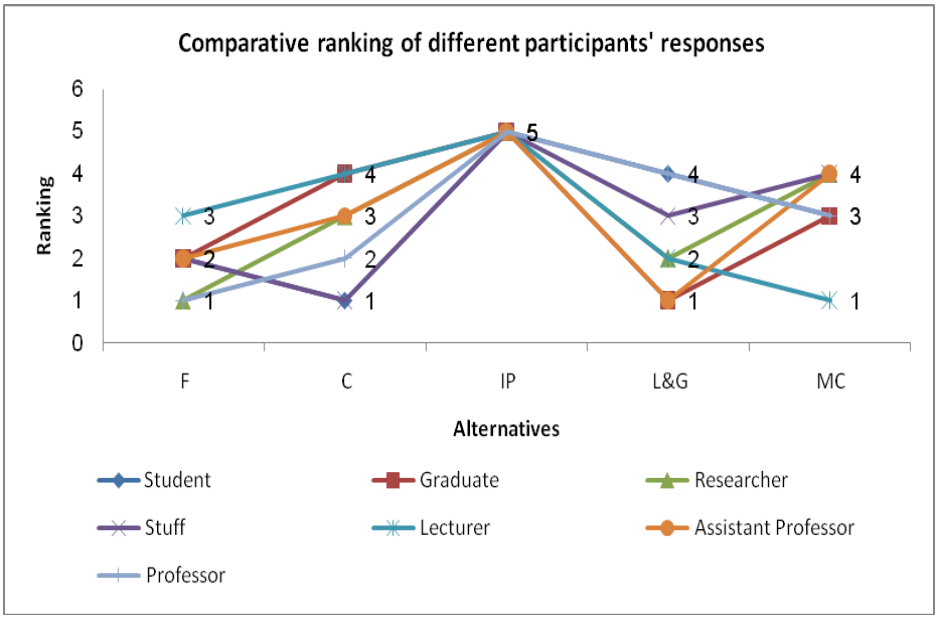

Fig. 1: Comparative ranking of different participants' responses

V. COMPUTING THE IMPORTANCE OF PERSPECTIVES

Step 1: Pair wise comparison matrix

Pair-wise comparison matrix which begins with comparing the relative importance of two selected items as shown in Table 5.

Table 5: Construct a Pair-wise Comparison Matrix

Goal	FL	CT	IP	L& G	MC
Financial (FL)	1	1.062	1.5292	1.0073	0.94
Customer CT	0.9416	1	1.4399	0.9485	0.89
Internal process(IP)	0.6539	0.6945	1	0.6587	0.62
Learning and growth(L&G)	0.9928	1.0543	1.5181	1	0.93
Management commitment (MC)	1.062	1.1279	1.624	1.0698	1

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Step 2: Synthesizing the Pair wise Comparison matrix.

The eq. (2) is used to calculate the vectors of priorities as shown in Table 6.

Table 6: Priority vector

Goal	FL	CT	IP	L& G	MC	FL	Total	PV
Financial (FL)	0.215	0.215	0.215	0.215	0.215	0.215	1.075	0.215
Customer CT	0.202	0.202	0.202	0.202	0.202	0.202	1.012	0.202
Internal process(IP)	0.141	0.141	0.141	0.141	0.141	0.141	0.703	0.141
Learning and growth(L&G)	0.213	0.213	0.213	0.213	0.213	0.213	1.067	0.213
Management commitment (MC)	0.228	0.228	0.228	0.228	0.228	0.228	1.142	0.228

Step 3: Perform the Consistency

To calculate the consistency ratio (CR), there are three steps to be implemented as follows:

- *Firstly*, Calculate the Eigen value (λ max) as shown in Table 7.

Table 7: the Eigen value (λ max)

FL		CT		IP		L& G		MC		NV
0.215	1	0.202	1.062	0.141	1.53	0.213	1.007	0.228	0.941	1.075
	0.9416		1		1.44		0.948		0.886	1.012
	0.6539		0.6945		1		0.658		0.615	0.703
	0.9928		1.0543		1.52		1		0.934	1.067
	1.062		1.1279		1.62		1.069		1	1.142

- *Secondly*, Calculate the Consistency Index (CI).

The CI can be calculated using the eq.(3).

$$CI=(5-5)/(5-1), \qquad CI= 0$$

- *Finally*, Calculate the Consistency Ratio (CR).

The CR can be calculated using the eq. (4). The random index (RI) value is selected from Table 3 (RI=1.12).

$$CR= 0$$

The value of CR is less than 0.1, the judgments are acceptable. After calculating priority victor for the first level (perspectives) of the hierarchy, then calculate the a priority victor for each level (objectives, and performance indicators) of hierarchy.

Step 4: Construct normalized decision matrix to rank the perspectives

This step transforms various attribute dimensions into non-dimensional attributes, by using eq. (5). To calculate the normalizing decision matrix, square each element of the matrix of alternatives. Then, sum of the squares of each element square in each column. After that, calculate the root for the sum in each column. Divide the elements in alternatives matrix of each column by the root in each column and the resulted normalized matrix stated in Table 8.

Table 8: Normalized decision matrix.

Goal	FL	CT	IP	L& G	MC
FL	0.475	0.475	0.475	0.475	0.475
CT	0.447	0.447	0.447	0.447	0.447
IP	0.311	0.311	0.311	0.311	0.311
L&G	0.472	0.472	0.472	0.472	0.472
MC	0.505	0.505	0.505	0.505	0.505

Step 5: Construct the weighted normalized decision matrix by using eq. (6). In this step multiply each column of the normalized decision matrix by its associated average weight in table 5 as shown in Table 9.

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Table 9: The weighted normalized decision matrix

Goal	FL	CT	IP	L& G	MC
FL	0.102	0.096	0.067	0.101	0.108
CT	0.096	0.090	0.063	0.095	0.102
IP	0.067	0.063	0.044	0.066	0.071
L&G	0.101	0.095	0.067	0.100	0.108
MC	0.109	0.102	0.071	0.108	0.115

Step 6: Determine the ideal and negative ideal solutions.

Ideal solution is calculated by using the eq. (7). Negative ideal solution is calculated by using the eq. (8). The ideal and negative ideal solution is presented in Table 10.

Table 10: Ideal and negative ideal solutions

v+	0.109	0.102	0.071	0.108	0.115
v-	0.067	0.063	0.044	0.066	0.071

Step 7: Calculate the separation measures for each alternative.

The separation from the ideal alternative is calculated by eq. (9). In this stage, each element in Colum in the weighted normalized decision matrix is subtracted from each element in column of ideal solution as show in Table 11. After that, sum each element in the row of separate on matrix. Calculate the root of the sum for each element in matrix to find the final separation. In the same way can calculate the separation from the negative ideal alternative by eq. (10).

Table 11: The separation from the ideal alternative

Goal	FL	CT	IP	L& G	MC
FL	0.00004	0.00004	0.00002	0.00004	0.00005
CT	0.00015	0.00013	0.00007	0.00015	0.00017
IP	0.00174	0.00153	0.00075	0.00171	0.00196
L&G	0.00005	0.00004	0.00002	0.00005	0.00006
MC	0.00000	0.00000	0.00000	0.00000	0.00000

Step 8: The relative closeness to the ideal solution is calculated by using the eq.(11). In this step each element in row of separation from the negative ideal alternative divides by the sum of separation ideal and negative ideal alternative. Then, the final ranking is presented in Table12.

Table 12: Result of ranking

Perspective	FL	CT	IP	L& G	MC
Rank	2	4	5	3	1

This proces is repeated for all stratgic objectives and all indecators. The result of the rank for all levels (perspectives, objectives, and performance indicators) is shown in Figure 2.

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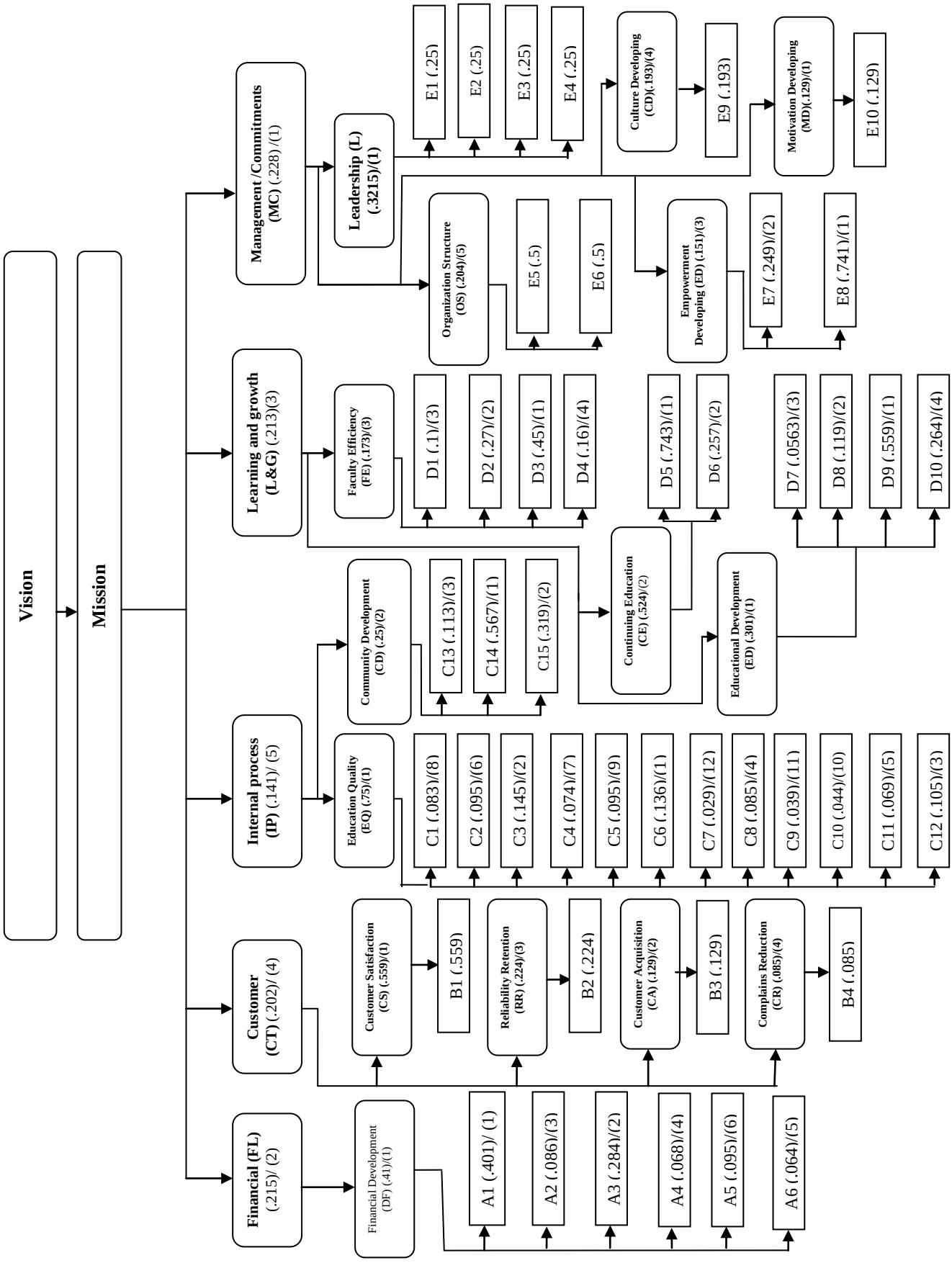

Fig. 2: The weights / ranking of the perspectives, objectives, and performance indicators

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VI. RESULTS

The results of this research show that "Management" is the most important perspective of educational balanced scorecard in faculty of engineering in the first level. It is noted from Table 13 that the most important perspective after management is finance and the least important is internal process. When going to the second level the result show that " Motivation development"," Education development", "Customer satisfaction", "Quality education service" and "Financial development" are considered as the most important objectives of educational balanced scorecard in faculty of engineering. According to the result of third level the "Budget allocated annually", "Number of laps found to factor required for each department."," Number of projects that involved the overall development of the environment", " Number of international conferences, which was attended by members of the faculty", " Number of international agreements for the exchange of graduates", " Number of practical projects, which was attended by members of the faculty in the development of society and the development environment", and " number of person motivated bar moth" are considered as most important indicators of educational balanced scorecard in faculty of engineering.

VII. CONCLUSION

The effectiveness of the higher education sector can be defined generally by, the degree to which the goals and objectives specified in higher education policies, plans, projects and programs are achieved to the satisfaction of the stakeholders. The ultimate objective of improving higher education effectiveness is the overall improvement in specifically the nation's human capital and generally, in national development while making the most efficient use of resources. This study used the BSC as a strategic tool to evaluation the faculty of engineering performance. AHP-TOPSIS model is used to prioritize levels of all BSC perspectives. The following conclusions could be drawing:

- The weights calculated by AHP-TOPSIS prioritize the importance of the BSC evaluation criteria for faculty of engineering performance with respect to the relative weights of the criteria, it not only revels the ranking order of the faculty performance but it also pinpoints the gaps to better achieve faculty goal by using the MCDM analytical methods.

- The proposed which integrate the BSC with MCDM method shows to be a feasible and effective assessment model for faculty of engineering performance evaluation and it could be extended to other faculties as well or digging deeply to assesses faculty department also.

- The result from AHP-TOPSIS model found out that management perspective has the first priority which means that it is the most important component of the five balanced scorecard perspectives the faculty performance.

- The most significant advantage of the use of the balanced scorecard is that it provide a wider development of metrics that are closely connected to the strategic goals of institution (here faculty of engineering).

- Organizing an appropriate set of metrics through an academic scorecard provides a useful way to conceptualize and display the overall education and financial performance of certain units with the organization.

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